PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2001-231078

(43)Date of publication of application : 24.08.2001

(51)Int.Cl. H04Q 7/38
H04B 7/15
H04B 7/26
H04L 12/28
H04L 12/56
H04L 29/08

(21)Application number : 2000-038681

(22)Date of filing : 16.02.2000

(71)Applicant : NIPPON TELEGR & TELEPH CORP <NTT>

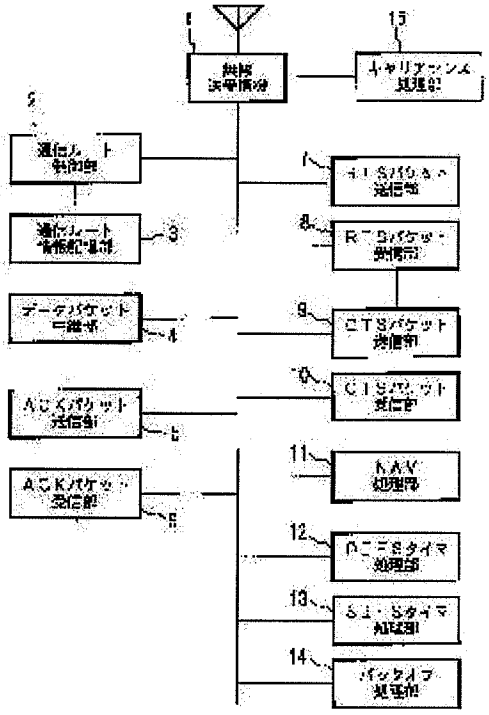
(72)Inventor : MIYAGI TOSHIFUMI
IIZUKA MASATAKA
MORIKURA MASAHIRO

(54) RADIO PACKET RELAY STATION AND RADIO PACKET RELAY METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a radio packet relay station that can shorten the realy time of a data packet and can prevent the data packet from being transmitted to a destination station due to the data packet staying in the relay station.

SOLUTION: When a relay station completes reception of a data packet from a relay station being a sender, the relay station transmits an RTS packet in place of an ACK to the relay station of the sender, the relay station of the sender receiving the RTS packet recognizes that the relay station normally receives the data packet and stops data packet transmission preparation until the transmission of the data packet described in the RTS packet is finished. A next relay station receiving the RTS packet transmits a CTS packet to the relay station when the next relay station is ready to receive the data packet after an SIFS and the relay station receiving the CTS packet recognizes that the next relay station is ready to receive the data packet and transmits the data packet to the next relay station after the SIFS.



LEGAL STATUS

[Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than

the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]
[Claim 1] It is a wireless packet relay center in the communication system which two or more radio stations use a common wireless carrier, and transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. The ready-for-sending acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after checking that carried out carrier sense between a certain fixed time amount Td, and the wireless circuit is vacant when the data signal which should be transmitted occurs, By said ready-for-sending acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, a data signal The wireless packet transmitting function which transmits said data signal as a wireless packet signal after a certain fixed time amount Ts (Ts<Td) after being able to check, The ready-for-receiving notice function to transmit the signal which notifies that to the relay center of said front if it is ability ready for receiving when the signal for checking whether a self-relay center is ability ready for receiving about a data signal from the relay center in front of a self-relay center is received, The wireless packet reception function in which the relay center of said front receives the data signal which checked that a self-relay center was ability ready for receiving, and has been transmitted as a wireless packet signal by said ready-for-receiving notice function, In order to carry out junction processing of the data signal received by said wireless packet reception function The junction good acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after a certain fixed time amount Ts since it finishes receiving this data signal, The wireless packet junction function to transmit said data signal as a wireless packet signal after a certain fixed time amount Ts after it can check a data signal by said junction good acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, A self-relay center supervises the signal which checks whether transmission of said data signal [further as opposed to the next relay center] of the next relay center which the next relay center transmits is possible. The wireless packet relay center characterized by providing the wireless packet signal junction acknowledgement function which checks that the wireless packet signal including the data signal which the self-relay center relayed has been normally received when reception of this signal is able to be checked.
[Claim 2] Two or more radio stations use a common wireless carrier, and it is in the wireless packet junction approach in the communication system which transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. When a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency The wireless packet junction approach characterized by including the step which transmits the RTS packet which judges whether a data packet is ability ready for receiving instead of the ACK packet which tells having carried out normal reception of the data packet to the relay center of said transmitting origin.
[Claim 3] The relay center of said transmitting origin which received said RTS packet is time amount until transmission of the data packet which recognizes it as said relay center having carried out normal

reception of the data packet, and is described by said RTS packet is completed, and the wireless packet junction approach according to claim 2 characterized by stopping a data packet transmitting preliminary treatment.

[Claim 4] Said relay center which transmitted the CTS packet for a transmitting check to said addressing to a relay center after between SIFS, and received this CTS packet when the next relay center which received said RTS packet was in the condition which self can data packet receive is the wireless packet junction approach according to claim 2 that a relay center besides the above is characterized by to recognize that it is in the condition in which data packet reception is possible, and to transmit said data packet to said following addressing to a relay center in between SIFS.

[Translation done.]

* NOTICES *

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] In case the wireless packet junction approach in the wireless packet relay center which carries out the radio relay of the data packet, and this wireless packet relay center is started and a relay center transmits a data packet to the next relay center on the communication link root especially, this invention is making the preparations which transmit quickly the data packet transmitted from the relay center of the communication link root kickback to the next relay center, and relates to the technique of relaying a data packet to a destination station quickly.
[0002]
[Description of the Prior Art] The "RTS-CTS-DATA-ACK" procedure of DCF (Distributed Coordination Function) of CSMA/CA defined by IEEE802.11 which is performing the global standardization, for example as a conventional technique of the wireless packet junction approach (the wireless access approach) that each stations in which a key station does not exist share a circuit mutually autonomously is well-known. This procedure is described by "IEEE P 802.11, Draft Standard for Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, P802.11 D 6.1, 9 May 1997." The conventional technique which applies this wireless access method to a radio relay is explained below.
[0003] Drawing 4 is the explanatory view having shown the junction procedure of the conventional radio relay station (wireless packet relay center). A relay center A is drawing having shown the example the relay center B is similarly relaying [example] the data packet which received to the relay center C to the relay center B.
[0004] A relay center A receives a data packet, and after it transmits the acknowledge (ACK) packet which shows the completion of reception of a data packet, it starts the processing which transmits a relay center B HEDETA packet. While a relay center A is called DIFS (DCF Inter Frame Space), other terminals supervise whether the circuit is used or not (it is called carrier sense below). Between DIFS(s), if it recognizes that the circuit is not used after performing carrier sense, the next processing will be started.
[0005] Here, when the circuit is used between DIFS(s), a circuit is vacant after that, and only while generating the random number and being specified with the value, the back-off processing which performs carrier sense is again started after the carrier sense of DIFS time amount. It becomes possible to reduce the probability of the collision with other stations because each station performs back-off processing.
[0006] After performing back-off processing between DIFS(s) or after between DIFS, a relay center A describes time amount until transmission of a data packet completes the RTS packet for judging whether a relay center B is in the condition that a data packet is receivable if it recognizes that the circuit is not used as a result of carrier sense in the meantime, and it transmits to relay center B.
[0007] Relay centers other than the relay center B which received the RTS packet recognize that the relay center A tends to transmit the data packet after this, and begin the carrier sense between DIFS(s)

after the time amount described in this.
[0008] If it recognizes that it is in the condition that a data packet is receivable, the relay center B which received the RTS packet is spacing called SIFS (Short Inter Frame Space), will describe time amount until a relay center A completes transmission of a data packet for the CTS packet which is a packet for a transmitting check, and will transmit it to relay center A.
[0009] relay centers other than the relay center A which received the CTS packet (for example, the relay center C) recognize that the relay center B tends to receive the data packet, and it is described in this -- time amount standby is carried out and the carrier sense between DIFS(s) is begun after that. The relay center A which received the CTS packet becomes possible [recognizing that it is in the condition that a relay center B is receivable], and transmits a data packet in between SIFS.
[0010] The relay center B which received the data packet will transmit the ACK packet which tells having received the data packet normally in between SIFS, if it recognizes having received the data packet normally. Each relay center repeats the same processing as the above, and a data packet is relayed to a destination station.
[0011]
[Problem(s) to be Solved by the Invention] As a technical problem which this invention tends to solve, when a relay center B carries out the completion of reception of a data packet in drawing 4 which is the sequence diagram of the conventional technique and an ACK packet is transmitted to a relay center A, the case where the data packet of the waiting for transmission is in a relay center A is considered. Relay centers A and B perform carrier sense between DIFS(s) in order to start the preparation which transmits a data packet.
[0012] Here, after being able to check that the carrier is vacant as a result of the carrier sense within between DIFS, each station generates a random number and starts the back-off processing only whose time amount specified with the value continues carrier sense. In this case, when a relay center A becomes ready-for-sending ability with a value smaller than a relay center B, a relay center B will refrain from data packet transmitting preparation until it will complete transmission of the data packet from a relay center A, if the RTS packet from a relay center A is received.
[0013] When it may be such and the count of junction increases repeatedly, there is a trouble that the time amount a relay center B relays [time amount] a data packet to a relay center C becomes late, and the throughput of the data packet to a destination station becomes low.
[0014] Moreover, even if the relay center B transmitted the data packet previously as one of the technical problems which this invention tends to solve on the occasion of back-off processing in the above-mentioned case, it will pass through the time amount of ACK air time +SIFS time amount +DIFS time amount (+ back-off processing time) by starting transmission of the data packet which the relay center A transmitted (RTS being transmitted). Therefore, there is a trouble that the junction of a data packet becomes slow and a throughput becomes low.
[0015] The purpose of this invention aims at offering the wireless packet relay center and the wireless packet junction approach which it was made since the above-mentioned technical problem was solved, and the time amount concerning junction processing of a data packet can be shortened, and a data packet is not overdue in a relay center, and can be quickly transmitted to a destination station.
[0016]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, the description of invention of claim 1 It is a wireless packet relay center in the communication system which two or more radio stations use a common wireless carrier, and transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. The ready-for-sending acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after checking that carried out carrier sense between a certain fixed time amount Td, and the wireless circuit is vacant when the data signal which should be transmitted occurs, By said ready-for-sending acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, a data signal The wireless packet transmitting function which transmits said data signal as a wireless packet signal after a certain fixed

time amount Ts (Ts<Td) after being able to check, The ready-for-receiving notice function to transmit the signal which notifies that to the relay center of said front if it is ability ready for receiving when the signal for checking whether a self-relay center is ability ready for receiving about a data signal from the relay center in front of a self-relay center is received, The wireless packet reception function in which the relay center of said front receives the data signal which checked that a self-relay center was ability ready for receiving, and has been transmitted as a wireless packet signal by said ready-for-receiving notice function, In order to carry out junction processing of the data signal received by said wireless packet reception function The junction good acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after a certain fixed time amount Ts since it finishes receiving this data signal, The wireless packet junction function to transmit said data signal as a wireless packet signal after a certain fixed time amount Ts after it can check a data signal by said junction good acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, A self-relay center supervises the signal which checks whether transmission of said data signal [further as opposed to the next relay center] of the next relay center which the next relay center transmits is possible. When reception of this signal is able to be checked, it is in providing the wireless packet signal junction acknowledgement function which checks that the wireless packet signal including the data signal which the self-relay center relayed has been received normally.

[0017] A wireless carrier with two or more common radio stations is used for the description of invention of claim 2. It is in the wireless packet junction approach in the communication system which transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. When a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency It is in the step which transmits the RTS packet which judges whether a data packet is ability ready for receiving instead of the ACK packet which tells having carried out normal reception of the data packet to the relay center of said transmitting origin being included.

[0018] The relay center of said transmitting origin the transmitting description of invention of claim 3 received said RTS packet is to stop time amount until transmission of the data packet which recognizes it as said relay center having carried out normal reception of the data packet, and is described by said RTS packet is completed, and a data packet transmitting preliminary treatment.

[0019] If the next relay center which received said RTS packet of invention of claim 4 is in the condition which self can data packet receive, it will recognize that said relay center which transmitted the CTS packet for a transmitting check to said addressing to a relay center after between SIFS, and received this CTS packet is in the condition which a relay center besides the above can data packet receive, and said data packet will be transmitted to said following addressing to a relay center in between SIFS.

[0020] According to this invention, when a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency, it has lost that a data packet is overdue in a relay center, and it becomes impossible to transmit instead of ACK quickly at a destination station while shortening the time amount which junction processing of a data packet takes by considering as the procedure of transmitting an RTS packet to the relay center of a transmitting agency.

[0021]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 is the block diagram having shown the configuration of 1 operation gestalt of the wireless packet relay center of this invention. The wireless packet relay center is equipped with a radio receiver-transmitter 1, the communication link root control section 2, the communication link root information storage section 3, the data packet junction section 4, the ACK packet transmitting section 5, the ACK packet receive section 6, the RTS packet transmitting section 7, the RTS packet receive section 8, the CTS packet transmitting section 9, the CTS packet receive section 10, the NAV processing section 11, the DIFS timer processing section 12, the SIFS timer processing section 13, the back-off processing section 14, and the carrier sense processing section 15.

[0022] Here, a radio receiver-transmitter 1 performs radio between the wireless packet relay center concerned and other wireless packet relay centers. The communication link root control section 2

manages the address of the station at the time of transmitting each packet etc. based on the communication link root information memorized in the communication link root information storage section 3. The data packet junction section 4 holds the data packet which received, and makes the preparations which relay a data packet with reference to the address obtained by the communication link root control section 2. If it checks that the data packet is normally receivable, the ACK packet transmitting section 5 will create the ACK packet for telling that, and will make the preparations for transmission.

[0023] The ACK packet receive section 6 recognizes having completed transmission of a data packet to a transmitting partner's station normally, after receiving an ACK packet. In case the RTS packet transmitting section 7 has the Request to Send of a data packet, it creates an RTS packet, describes the time amount (Duration) which transmission of a data packet completes, and prepares transmission. After it receives the RTS packet transmitted from the station, the RTS packet receive section 8 recognizes the address of a transmission place, when a transmission place is an own terminal, it moves to the CTS packet transmitting section 9, and when a transmission place is not an own terminal, it moves to the NAV processing section 11.

[0024] From the RTS packet receive section 8, when there is a demand of CTS packet creation, the CTS packet transmitting section 9 creates a CTS packet, describes the time amount (Duration) which transmission of a data packet completes, and prepares transmission. After it receives a CTS packet, the CTS packet receive section 10 recognizes the address of a transmission place, when a transmission place is an own terminal, it moves to preparation of data packet transmission in the data packet junction section 4, and when a transmission place is not an own terminal, it moves to the NAV processing section 11.

[0025] The NAV processing section 11 stands by the transmitting processing of RTS (DIFS timer + back-off processing) and a CTS packet which is a data packet transmitting preliminary treatment to the Duration time amount described in RTS or CTS. When the DIFS timer processing section 12 has a data packet Request to Send, it performs carrier sense by the carrier sense processing section 15 only between the DIFS time amount set up beforehand, and supervises whether there is any transmission of the packet from other stations. If processing of the packet from other stations is recognized, after starting a DIFS timer again and carrying out timer expiration from the moment transmission of a packet finished and the circuit was vacant, it moves to the back-off processing section 14. When the SIFS timer processing section 13 has the Request to Send of a CTS packet, an ACK packet, and a data packet, it makes preparations of transmission only between the SIFS time amount set up beforehand.

[0026] When a DIFS timer becomes time amount expiration by back-off processing in the DIFS timer processing section 12, the back-off processing section 14 generates a random number, performs carrier sense by the specified time amount carrier sense processing section 15, and supervises whether there is any transmission from other packets. Here, if transmission of the packet from other stations is recognized, it will move to the DIFS timer processing section 12.

[0027] Drawing 2 is the explanatory view having shown 1 operation gestalt of the wireless packet junction approach of this invention, and explains the transceiver procedure at the time of transmitting a data packet to the wireless packet relay center C through the wireless packet relay center B from the wireless packet relay center A of a configuration of having been shown in drawing 1 .

[0028] Drawing 3 is the sequence diagram having shown actuation of each station at the time of transmitting a data packet to the wireless packet relay center C through the wireless packet relay center B from the wireless packet relay center A in the transceiver procedure shown in drawing 2 .

[0029] Next, actuation of this operation gestalt is explained with reference to drawing 2 and drawing 3 . Drawing 2 and drawing 3 show the situation of relaying the data packet in order of relay centers B and C, from the transmitting agency office A. The transmitting agency station A prepares (step 301a) and an RTS packet, when there is a demand of data packet transmission. In case the transmitting agency station A transmits an RTS packet, while being referred to as DIFS, it performs carrier sense as well as the conventional technique (step 302a). After performing carrier sense between DIFS(s), the packet is not transmitted from other stations, and if it recognizes that the circuit is vacant, an RTS packet will be

transmitted to relay center B (step 303a). The time amount taken to complete transmission of a relay center B HEDETA packet from the transmitting agency station A into an RTS packet is described.
[0030] Here, if the packet transmission from other stations is checked in the carrier sense between DIFS (s), transmission of the packet of other stations will be completed and a DIFS timer will be again started from the moment of having recognized it as the circuit being vacant. A random number is generated after DIFS timer completion, and only while being specified with the value, the back-off processing which performs carrier sense is started. In the meantime, an RTS packet will be transmitted if transmission of the packet from other stations is not sensed.
[0031] It judges whether a relay center B is in the condition that the data packet from the transmitting agency station A is receivable, when an RTS packet is received (step 301b). If it is not in a receivable condition, it will not answer (step 302b). If it is in a receivable condition, a CTS packet will be transmitted for the passage of time called SIFS to waiting (step 303b) and transmitting agency station A (step 304b). The time amount taken to complete transmission of a relay center B HEDETA packet from the transmitting agency station A like [a CTS packet] an RTS packet is described.
[0032] Here, only the time amount described in the CTS packet sets up NAV, and relay centers other than the transmitting agency station A which received the CTS packet (for example, the relay center C) suspend processing of data packet transmitting preparation.
[0033] A relay center B becomes possible [recognizing that it is in the condition in which data packet reception is possible], and the transmitting agency station A which received the CTS packet transmits a data packet for progress between SIFS(s) to waiting (step 304a) and relay center B (305a). An RTS packet is transmitted to relay center C which is the relay center of a waiting (step 305b) and communication link root top and a degree about the relay center B which received the data packet normally passing between SIFS(s) (step 306b).
[0034] The transmitting agency station A which received the RTS packet is receiving an RTS packet to the time amount which receives the ACK packet which originally notifies the completion of normal transmitting of a data packet, and it recognizes that transmission of the data packet to a relay center B was completed normally. Then, the transmitting agency office A sets up NAV and stops a data packet transmitting preliminary treatment until a relay center B completes transmission of the data packet addressed to a relay center C.
[0035] It judges whether the relay center C which received the RTS packet is in the condition which self can data packet receive (step 301c). If it is not in a receivable condition, it will not answer (step 302c). If it is in a receivable condition, a CTS packet will be transmitted for passing between SIFS(s) to waiting (step 303c) and relay center B (step 304c).
[0036] It becomes possible [the relay center B which received the CTS packet] to recognize that a relay center C is in the condition in which data packet reception is possible, and a data packet is transmitted for passing between SIFS(s) to waiting (step 307b) and relay center C (step 308b). The relay center C which received the data packet normally transmits an RTS packet to the relay center which is the next relay center on the communication link root after the progress between SIFS(s) (step 305c) (step 306c). Junction of a data packet is performed by being repeated until a data packet is sent for the above processing to a destination station in each relay center.
[0037] According to this operation gestalt, even when a relay center B carries out the completion of reception of the data packet from a relay center A and the data packet of the waiting for transmission is in a relay center A at this time in order to transmit not ACK but an RTS packet to a relay center A, a relay center B can send said data packet which received to a relay center C quickly in between SIFS. It can prevent that a data packet is overdue in a relay center B, and junction processing of a data packet becomes impossible very much by this.
[0038] Moreover, originally, by making the function of the ACK packet which notifies the completion of normal reception of a data packet to the RTS packet which judges whether it is ability ready for receiving hold, a data packet can shorten the time amount equivalent to ACK air time +DIFS time amount (+ back-off processing time), can shorten the time amount concerning junction processing of a data packet, and can make the throughput to the destination high.

[0039]
[Effect of the Invention] As explained to the detail above, by using the wireless packet relay center of this invention, and the wireless packet junction approach from a transmitting agency station to a destination station By making the function of the ACK packet which notifies the completion of normal reception of a data packet to the RTS packet which requests a transmitting check hold, in case a data packet is made to relay using a relay center The time amount equivalent to ACK air time +DIFS time amount (+ back-off processing time) can be shortened, and a relay center can relay a data packet quickly. Since this becomes possible to relay a data packet preferentially and a transmitting agency station is still enabled to shorten the time amount to transmission of the following data packet, it is lost that a data packet is overdue in a relay center, and there is effectiveness which can be quickly relayed to a destination station.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL FIELD

[Field of the Invention] In case the wireless packet junction approach in the wireless packet relay center which carries out the radio relay of the data packet, and this wireless packet relay center is started and a relay center transmits a data packet to the next relay center on the communication link root especially, this invention is making the preparations which transmit quickly the data packet transmitted from the relay center of the communication link root kickback to the next relay center, and relates to the technique of relaying a data packet to a destination station quickly.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

PRIOR ART

[Description of the Prior Art] The "RTS-CTS-DATA-ACK" procedure of DCF (Distributed Coordination Function) of CSMA/CA defined by IEEE802.11 which is performing the global standardization, for example as a conventional technique of the wireless packet junction approach (the wireless access approach) that each stations in which a key station does not exist share a circuit mutually autonomously is well-known. This procedure is described by "IEEE P 802.11, Draft Standard for Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification, P802.11 D 6.1, 9 May 1997." The conventional technique which applies this wireless access method to a radio relay is explained below.
[0003] Drawing 4 is the explanatory view having shown the junction procedure of the conventional radio relay station (wireless packet relay center). A relay center A is drawing having shown the example the relay center B is similarly relaying [example] the data packet which received to the relay center C to the relay center B.
[0004] A relay center A receives a data packet, and after it transmits the acknowledge (ACK) packet which shows the completion of reception of a data packet, it starts the processing which transmits a relay center B HEDETA packet. While a relay center A is called DIFS (DCF Inter Frame Space), other terminals supervise whether the circuit is used or not (it is called carrier sense below). Between DIFS(s), if it recognizes that the circuit is not used after performing carrier sense, the next processing will be started.
[0005] Here, when the circuit is used between DIFS(s), a circuit is vacant after that, and only while generating the random number and being specified with the value, the back-off processing which performs carrier sense is again started after the carrier sense of DIFS time amount. It becomes possible to reduce the probability of the collision with other stations because each station performs back-off processing.
[0006] After performing back-off processing between DIFS(s) or after between DIFS, a relay center A describes time amount until transmission of a data packet completes the RTS packet for judging whether a relay center B is in the condition that a data packet is receivable if it recognizes that the circuit is not used as a result of carrier sense in the meantime, and it transmits to relay center B.
[0007] Relay centers other than the relay center B which received the RTS packet recognize that the relay center A tends to transmit the data packet after this, and begin the carrier sense between DIFS(s) after the time amount described in this.
[0008] If it recognizes that it is in the condition that a data packet is receivable, the relay center B which received the RTS packet is spacing called SIFS (Short Inter Frame Space), will describe time amount until a relay center A completes transmission of a data packet for the CTS packet which is a packet for a transmitting check, and will transmit it to relay center A.
[0009] relay centers other than the relay center A which received the CTS packet (for example, the relay center C) recognize that the relay center B tends to receive the data packet, and it is described in this -- time amount standby is carried out and the carrier sense between DIFS(s) is begun after that. The relay center A which received the CTS packet becomes possible [recognizing that it is in the condition that a

relay center B is receivable], and transmits a data packet in between SIFS.
[0010] The relay center B which received the data packet will transmit the ACK packet which tells having received the data packet normally in between SIFS, if it recognizes having received the data packet normally. Each relay center repeats the same processing as the above, and a data packet is relayed to a destination station.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

EFFECT OF THE INVENTION

[Effect of the Invention] As explained to the detail above, by using the wireless packet relay center of this invention, and the wireless packet junction approach from a transmitting agency station to a destination station By making the function of the ACK packet which notifies the completion of normal reception of a data packet to the RTS packet which requests a transmitting check hold, in case a data packet is made to relay using a relay center The time amount equivalent to ACK air time +DIFS time amount (+ back-off processing time) can be shortened, and a relay center can relay a data packet quickly. Since this becomes possible to relay a data packet preferentially and a transmitting agency station is still enabled to shorten the time amount to transmission of the following data packet, it is lost that a data packet is overdue in a relay center, and there is effectiveness which can be quickly relayed to a destination station.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As a technical problem which this invention tends to solve, when a relay center B carries out the completion of reception of a data packet in drawing 4 which is the sequence diagram of the conventional technique and an ACK packet is transmitted to a relay center A, the case where the data packet of the waiting for transmission is in a relay center A is considered. Relay centers A and B perform carrier sense between DIFS(s) in order to start the preparation which transmits a data packet.
[0012] Here, after being able to check that the carrier is vacant as a result of the carrier sense within between DIFS, each station generates a random number and starts the back-off processing only whose time amount specified with the value continues carrier sense. In this case, when a relay center A becomes ready-for-sending ability with a value smaller than a relay center B, a relay center B will refrain from data packet transmitting preparation until it will complete transmission of the data packet from a relay center A, if the RTS packet from a relay center A is received.
[0013] When it may be such and the count of junction increases repeatedly, there is a trouble that the time amount a relay center B relays [time amount] a data packet to a relay center C becomes late, and the throughput of the data packet to a destination station becomes low.
[0014] Moreover, even if the relay center B transmitted the data packet previously as one of the technical problems which this invention tends to solve on the occasion of back-off processing in the above-mentioned case, it will pass through the time amount of ACK air time +SIFS time amount +DIFS time amount (+ back-off processing time) by starting transmission of the data packet which the relay center A transmitted (RTS being transmitted). Therefore, there is a trouble that the junction of a data packet becomes slow and a throughput becomes low.
[0015] The purpose of this invention aims at offering the wireless packet relay center and the wireless packet junction approach which it was made since the above-mentioned technical problem was solved, and the time amount concerning junction processing of a data packet can be shortened, and a data packet is not overdue in a relay center, and can be quickly transmitted to a destination station.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

MEANS

[Means for Solving the Problem] In order to attain the above-mentioned purpose, the description of invention of claim 1 It is a wireless packet relay center in the communication system which two or more radio stations use a common wireless carrier, and transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. The ready-for-sending acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after checking that carried out carrier sense between a certain fixed time amount Td, and the wireless circuit is vacant when the data signal which should be transmitted occurs, By said ready-for-sending acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, a data signal The wireless packet transmitting function which transmits said data signal as a wireless packet signal after a certain fixed time amount Ts (Ts<Td) after being able to check, The ready-for-receiving notice function to transmit the signal which notifies that to the relay center of said front if it is ability ready for receiving when the signal for checking whether a self-relay center is ability ready for receiving about a data signal from the relay center in front of a self-relay center is received, The wireless packet reception function in which the relay center of said front receives the data signal which checked that a self-relay center was ability ready for receiving, and has been transmitted as a wireless packet signal by said ready-for-receiving notice function, In order to carry out junction processing of the data signal received by said wireless packet reception function The junction good acknowledgement function which transmits the signal for checking whether it is ready-for-sending ability to the next relay center after a certain fixed time amount Ts since it finishes receiving this data signal, The wireless packet junction function to transmit said data signal as a wireless packet signal after a certain fixed time amount Ts after it can check a data signal by said junction good acknowledgement function, when said next relay center is able to check that it is ability ready for receiving, A self-relay center supervises the signal which checks whether transmission of said data signal [further as opposed to the next relay center] of the next relay center which the next relay center transmits is possible. When reception of this signal is able to be checked, it is in providing the wireless packet signal junction acknowledgement function which checks that the wireless packet signal including the data signal which the self-relay center relayed has been received normally.
[0017] A wireless carrier with two or more common radio stations is used for the description of invention of claim 2. It is in the wireless packet junction approach in the communication system which transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. When a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency It is in the step which transmits the RTS packet which judges whether a data packet is ability ready for receiving instead of the ACK packet which tells having carried out normal reception of the data packet to the relay center of said transmitting origin being included.
[0018] The relay center of said transmitting origin the transmitting description of invention of claim 3 received said RTS packet is to stop time amount until transmission of the data packet which recognizes it as said relay center having carried out normal reception of the data packet, and is described by said

RTS packet is completed, and a data packet transmitting preliminary treatment.
[0019] If the next relay center which received said RTS packet of invention of claim 4 is in the condition which self can data packet receive, it will recognize that said relay center which transmitted the CTS packet for a transmitting check to said addressing to a relay center after between SIFS, and received this CTS packet is in the condition which a relay center besides the above can data packet receive, and said data packet will be transmitted to said following addressing to a relay center in between SIFS.
[0020] According to this invention, when a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency, it has lost that a data packet is overdue in a relay center, and it becomes impossible to transmit instead of ACK quickly at a destination station while shortening the time amount which junction processing of a data packet takes by considering as the procedure of transmitting an RTS packet to the relay center of a transmitting agency.
[0021]
[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained based on a drawing. Drawing 1 is the block diagram having shown the configuration of 1 operation gestalt of the wireless packet relay center of this invention. The wireless packet relay center is equipped with a radio receiver-transmitter 1, the communication link root control section 2, the communication link root information storage section 3, the data packet junction section 4, the ACK packet transmitting section 5, the ACK packet receive section 6, the RTS packet transmitting section 7, the RTS packet receive section 8, the CTS packet transmitting section 9, the CTS packet receive section 10, the NAV processing section 11, the DIFS timer processing section 12, the SIFS timer processing section 13, the back-off processing section 14, and the carrier sense processing section 15.
[0022] Here, a radio receiver-transmitter 1 performs radio between the wireless packet relay center concerned and other wireless packet relay centers. The communication link root control section 2 manages the address of the station at the time of transmitting each packet etc. based on the communication link root information memorized in the communication link root information storage section 3. The data packet junction section 4 holds the data packet which received, and makes the preparations which relay a data packet with reference to the address obtained by the communication link root control section 2. If it checks that the data packet is normally receivable, the ACK packet transmitting section 5 will create the ACK packet for telling that, and will make the preparations for transmission.
[0023] The ACK packet receive section 6 recognizes having completed transmission of a data packet to a transmitting partner's station normally, after receiving an ACK packet. In case the RTS packet transmitting section 7 has the Request to Send of a data packet, it creates an RTS packet, describes the time amount (Duration) which transmission of a data packet completes, and prepares transmission. After it receives the RTS packet transmitted from the station, the RTS packet receive section 8 recognizes the address of a transmission place, when a transmission place is an own terminal, it moves to the CTS packet transmitting section 9, and when a transmission place is not an own terminal, it moves to the NAV processing section 11.
[0024] From the RTS packet receive section 8, when there is a demand of CTS packet creation, the CTS packet transmitting section 9 creates a CTS packet, describes the time amount (Duration) which transmission of a data packet completes, and prepares transmission. After it receives a CTS packet, the CTS packet receive section 10 recognizes the address of a transmission place, when a transmission place is an own terminal, it moves to preparation of data packet transmission in the data packet junction section 4, and when a transmission place is not an own terminal, it moves to the NAV processing section 11.
[0025] The NAV processing section 11 stands by the transmitting processing of RTS (DIFS timer + back-off processing) and a CTS packet which is a data packet transmitting preliminary treatment to the Duration time amount described in RTS or CTS. When the DIFS timer processing section 12 has a data packet Request to Send, it performs carrier sense by the carrier sense processing section 15 only between the DIFS time amount set up beforehand, and supervises whether there is any transmission of the packet from other stations. If processing of the packet from other stations is recognized, after starting

a DIFS timer again and carrying out timer expiration from the moment transmission of a packet finished and the circuit was vacant, it moves to the back-off processing section 14. When the SIFS timer processing section 13 has the Request to Send of a CTS packet, an ACK packet, and a data packet, it makes preparations of transmission only between the SIFS time amount set up beforehand.
[0026] When a DIFS timer becomes time amount expiration by back-off processing in the DIFS timer processing section 12, the back-off processing section 14 generates a random number, performs carrier sense by the specified time amount carrier sense processing section 15, and supervises whether there is any transmission from other packets. Here, if transmission of the packet from other stations is recognized, it will move to the DIFS timer processing section 12.
[0027] Drawing 2 is the explanatory view having shown 1 operation gestalt of the wireless packet junction approach of this invention, and explains the transceiver procedure at the time of transmitting a data packet to the wireless packet relay center C through the wireless packet relay center B from the wireless packet relay center A of a configuration of having been shown in drawing 1 .
[0028] Drawing 3 is the sequence diagram having shown actuation of each station at the time of transmitting a data packet to the wireless packet relay center C through the wireless packet relay center B from the wireless packet relay center A in the transceiver procedure shown in drawing 2 .
[0029] Next, actuation of this operation gestalt is explained with reference to drawing 2 and drawing 3 . Drawing 2 and drawing 3 show the situation of relaying the data packet in order of relay centers B and C, from the transmitting agency office A. The transmitting agency station A prepares (step 301a) and an RTS packet, when there is a demand of data packet transmission. In case the transmitting agency station A transmits an RTS packet, while being referred to as DIFS, it performs carrier sense as well as the conventional technique (step 302a). After performing carrier sense between DIFS(s), the packet is not transmitted from other stations, and if it recognizes that the circuit is vacant, an RTS packet will be transmitted to relay center B (step 303a). The time amount taken to complete transmission of a relay center B HEDETA packet from the transmitting agency station A into an RTS packet is described.
[0030] Here, if the packet transmission from other stations is checked in the carrier sense between DIFS (s), transmission of the packet of other stations will be completed and a DIFS timer will be again started from the moment of having recognized it as the circuit being vacant. A random number is generated after DIFS timer completion, and only while being specified with the value, the back-off processing which performs carrier sense is started. In the meantime, an RTS packet will be transmitted if transmission of the packet from other stations is not sensed.
[0031] It judges whether a relay center B is in the condition that the data packet from the transmitting agency station A is receivable, when an RTS packet is received (step 301b). If it is not in a receivable condition, it will not answer (step 302b). If it is in a receivable condition, a CTS packet will be transmitted for the passage of time called SIFS to waiting (step 303b) and transmitting agency station A (step 304b). The time amount taken to complete transmission of a relay center B HEDETA packet from the transmitting agency station A like [a CTS packet] an RTS packet is described.
[0032] Here, only the time amount described in the CTS packet sets up NAV, and relay centers other than the transmitting agency station A which received the CTS packet (for example, the relay center C) suspend processing of data packet transmitting preparation.
[0033] A relay center B becomes possible [recognizing that it is in the condition in which data packet reception is possible], and the transmitting agency station A which received the CTS packet transmits a data packet for progress between SIFS(s) to waiting (step 304a) and relay center B (305a). An RTS packet is transmitted to relay center C which is the relay center of a waiting (step 305b) and communication link root top and a degree about the relay center B which received the data packet normally passing between SIFS(s) (step 306b).
[0034] The transmitting agency station A which received the RTS packet is receiving an RTS packet to the time amount which receives the ACK packet which originally notifies the completion of normal transmitting of a data packet, and it recognizes that transmission of the data packet to a relay center B was completed normally. Then, the transmitting agency office A sets up NAV and stops a data packet transmitting preliminary treatment until a relay center B completes transmission of the data packet

addressed to a relay center C.
[0035] It judges whether the relay center C which received the RTS packet is in the condition which self can data packet receive (step 301c). If it is not in a receivable condition, it will not answer (step 302c). If it is in a receivable condition, a CTS packet will be transmitted for passing between SIFS(s) to waiting (step 303c) and relay center B (step 304c).
[0036] It becomes possible [the relay center B which received the CTS packet] to recognize that a relay center C is in the condition in which data packet reception is possible, and a data packet is transmitted for passing between SIFS(s) to waiting (step 307b) and relay center C (step 308b). The relay center C which received the data packet normally transmits an RTS packet to the relay center which is the next relay center on the communication link root after the progress between SIFS(s) (step 305c) (step 306c). Junction of a data packet is performed by being repeated until a data packet is sent for the above processing to a destination station in each relay center.
[0037] According to this operation gestalt, even when a relay center B carries out the completion of reception of the data packet from a relay center A and the data packet of the waiting for transmission is in a relay center A at this time in order to transmit not ACK but an RTS packet to a relay center A, a relay center B can send said data packet which received to a relay center C quickly in between SIFS. It can prevent that a data packet is overdue in a relay center B, and junction processing of a data packet becomes impossible very much by this.
[0038] Moreover, originally, by making the function of the ACK packet which notifies the completion of normal reception of a data packet to the RTS packet which judges whether it is ability ready for receiving hold, a data packet can shorten the time amount equivalent to ACK air time +DIFS time amount (+ back-off processing time), can shorten the time amount concerning junction processing of a data packet, and can make the throughput to the destination high.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram having shown the configuration of 1 operation gestalt of the wireless packet relay center of this invention.
[Drawing 2] It is the explanatory view having shown 1 operation gestalt of the wireless packet junction approach of this invention.
[Drawing 3] It is the sequence diagram having shown actuation of each station at the time of transmitting a data packet to the wireless packet relay center C through the wireless packet relay center B from the wireless packet relay center A in the transceiver procedure shown in drawing 2 .
[Drawing 4] It is the explanatory view having shown the junction procedure of the conventional radio relay station (wireless packet relay center).
[Description of Notations]
1 Radio Receiver-transmitter
2 Communication Link Root Control Section
3 Communication Link Root Information Storage Section
4 Data Packet Junction Section
5 ACK Packet Transmitting Section
6 ACK Packet Receive Section
7 RTS Packet Transmitting Section
8 RTS Packet Receive Section
9 CTS Packet Transmitting Section
10 CTS Packet Receive Section
11 NAV Processing Section
12 DIFS Timer Processing Section
13 SIFS Timer Processing Section
14 Back-Off Processing Section
15 Carrier Sense Processing Section
A, B, C Wireless packet relay center

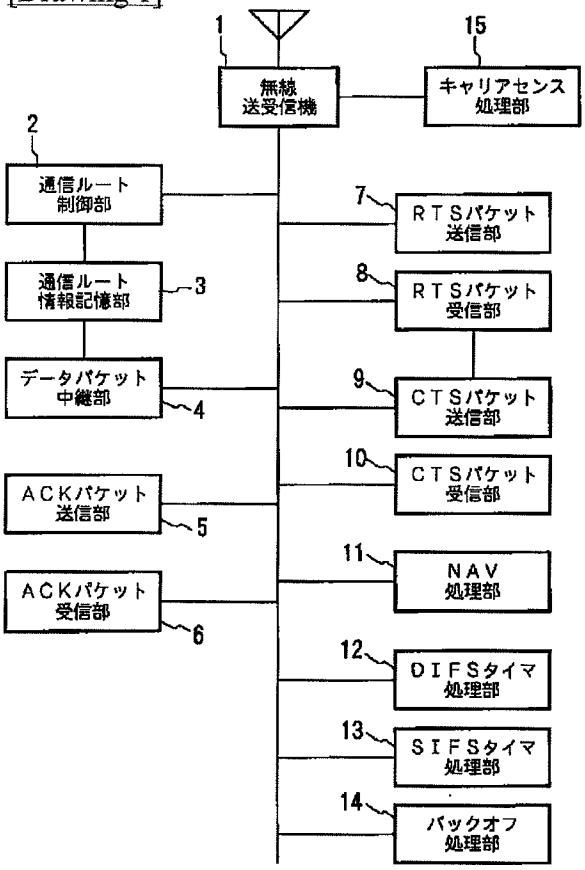
[Translation done.]

* NOTICES *

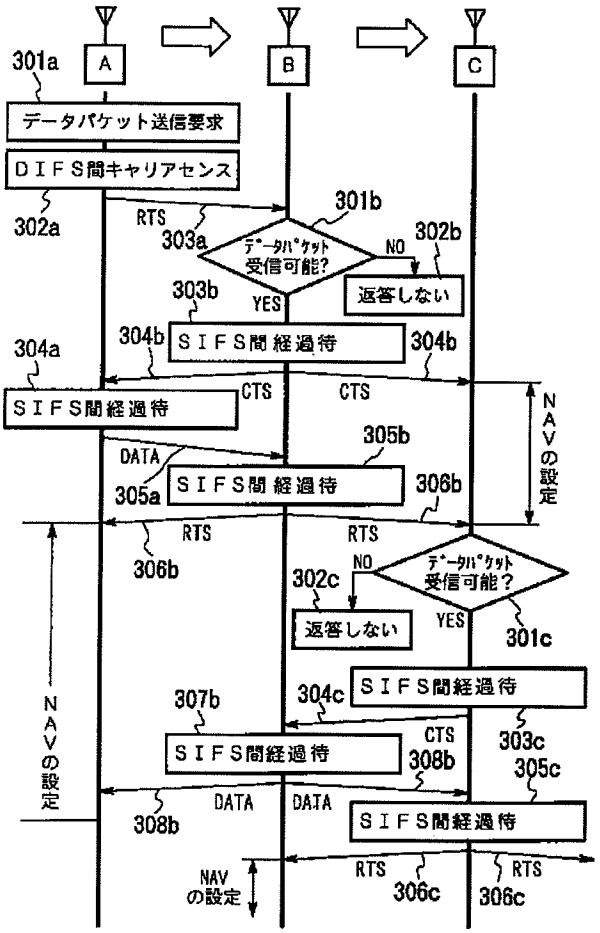
1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DRAWINGS

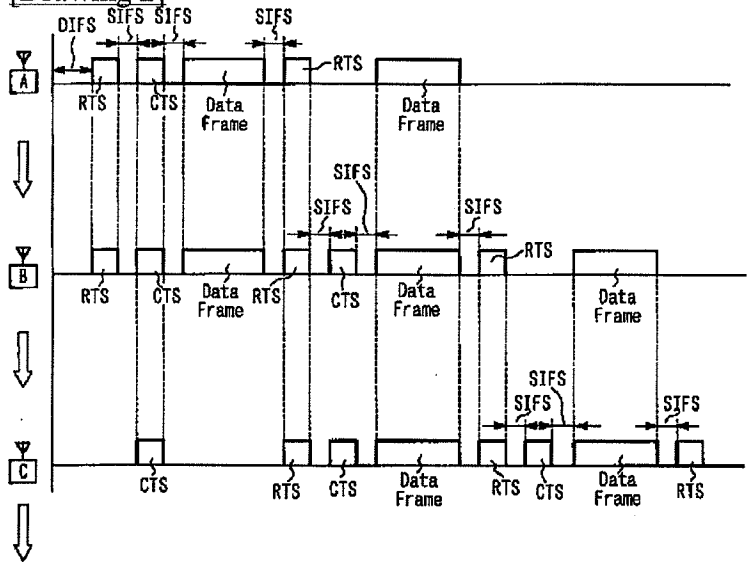
[Drawing 1]



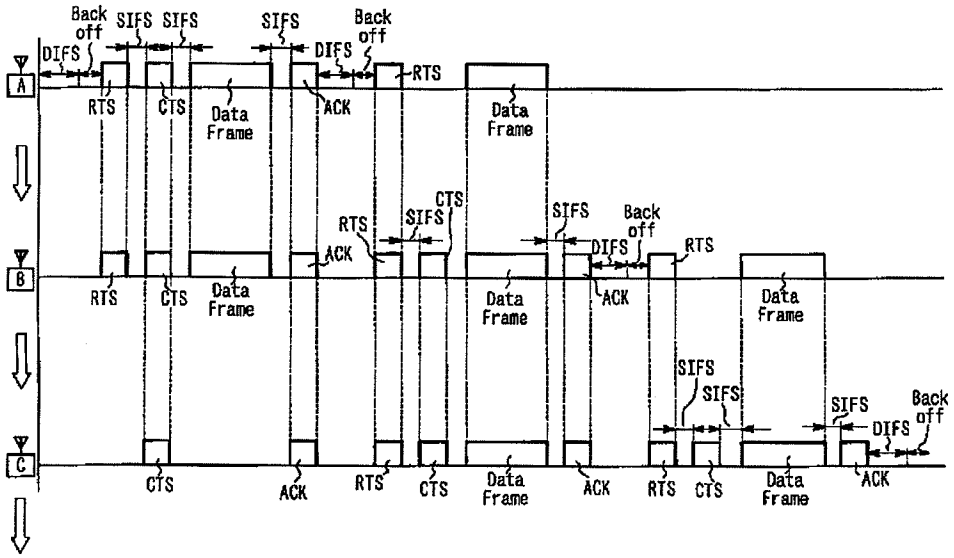
[Drawing 3]



[Drawing 2]



[Drawing 4]



[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

WRITTEN AMENDMENT

---------- [a procedure revision]
[Filing Date] March 16, Heisei 12 (2000. 3.16)
[Procedure amendment 1]
[Document to be Amended] Specification
[Item(s) to be Amended] Claim 2
[Method of Amendment] Modification
[Proposed Amendment]
[Claim 2] Two or more radio stations use a common wireless carrier, and are in the wireless packet junction approach in the communication system which transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal,
The wireless packet junction approach characterized by including the step which transmits the RTS packet for judging whether a data packet is ability ready for receiving to the next relay center instead of the ACK packet which tells a front relay center about having carried out normal reception of the data packet when a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency.
[Procedure amendment 2]
[Document to be Amended] Specification
[Item(s) to be Amended] 0017
[Method of Amendment] Modification
[Proposed Amendment]
[0017] A wireless carrier with two or more common radio stations is used for the description of invention of claim 2. It is in the wireless packet junction approach in the communication system which transmits a wireless packet signal to an independence distribution target by carrying out junction processing to the radio station of a request of a wireless packet signal. When a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency It is in the step which transmits the RTS packet for judging whether a data packet is ability ready for receiving to the next relay center instead of the ACK packet which tells a front relay center about having carried out normal reception of the data packet being included.
[Procedure amendment 3]
[Document to be Amended] Specification
[Item(s) to be Amended] 0020
[Method of Amendment] Modification
[Proposed Amendment]
[0020] When a relay center carries out the completion of reception of the data packet from the relay center of a transmitting agency, while shortening the time amount which junction processing of a data packet takes by transmitting the RTS packet for judging whether a data packet is ability ready for

receiving to the next relay center instead of ACK for telling a front relay center about a data packet according to this invention, it has lost that a data packet is overdue in a relay center, and it becomes impossible to transmit to a destination station quickly.

[Procedure amendment 4]
[Document to be Amended] Specification
[Item(s) to be Amended] 0034
[Method of Amendment] Modification
[Proposed Amendment]
[0034] Since the transmitting agency office A which received the RTS packet is receivable to the time amount which receives the ACK packet which originally notifies the completion of normal transmitting of a data packet for the RTS packet addressed to a relay center C from said relay center B, it recognizes that transmission of the data packet to a relay center B was completed normally by receiving this RTS packet. Then, the transmitting agency office A sets up NAV and stops a data packet transmitting preliminary treatment until a relay center B completes transmission of the data packet addressed to a relay center C.

[Procedure amendment 5]
[Document to be Amended] Specification
[Item(s) to be Amended] 0037
[Method of Amendment] Modification
[Proposed Amendment]
[0037] When a relay center B carries out the completion of reception of the data packet from a relay center A according to this operation gestalt, Since the purport which the relay center A could receive the RTS packet to a relay center C instead of the ACK packet, and the transmission to a relay center B ended normally can be recognized Even when the data packet of the waiting for transmission is in a relay center A at this time, a relay center B can send said data packet which received to a relay center C quickly in between SIFS. It can prevent that a data packet is overdue in a relay center B, and junction processing of a data packet becomes impossible very much by this.

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2001－231078
（P2001－231078A）
(43)公開日　平成13年８月24日(2001.8.24)

(51)Int.Cl.'	識別記号	ＦＩ		テーマコード'（参考）
Ｈ０４Ｑ　7/38		Ｈ０４Ｂ　7/26	１０９Ｍ	５Ｋ０３０
Ｈ０４Ｂ　7/15			7/15	Ｚ	５Ｋ０３３
7/26			7/26	Ａ	５Ｋ０３４
Ｈ０４Ｌ　12/28		Ｈ０４Ｌ	11/00	３１０Ｂ	５Ｋ０６７
12/56			11/20	１０２Ａ	５Ｋ０７２

審査請求　未請求　請求項の数４　ＯＬ　（全８頁）　最終頁に続く

(21)出願番号　特願2000－38631(P2000－38631)

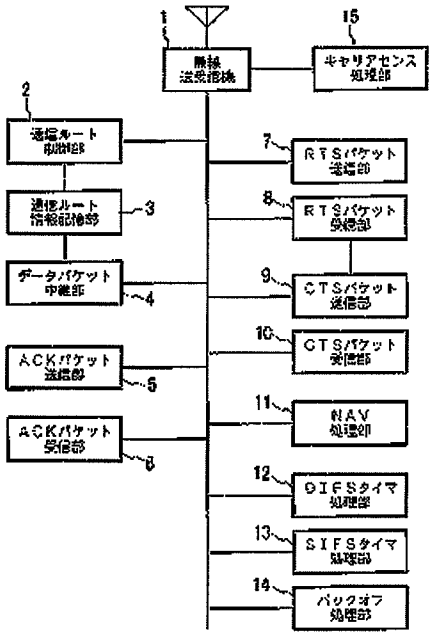
(22)出願日　平成12年２月16日(2000.2.16)

(71)出願人　000004226
日本電信電話株式会社
東京都千代田区大手町二丁目３番１号
(72)発明者　宮城　利文
東京都千代田区大手町二丁目３番１号　日本電信電話株式会社内
(72)発明者　飯塚　正孝
東京都千代田区大手町二丁目３番１号　日本電信電話株式会社内
(74)代理人　100064908
弁理士　志賀　正武

最終頁に続く

(54)【発明の名称】　無線パケット中継局及び無線パケット中継方法

(57)【要約】
【課題】　データパケットの中継処理時間を短縮することができ且つデータパケットが中継局に滞って宛先局に迅速に送信できなくなることを無くすこと。
【解決手段】　中継局が送信元の中継局からのデータパケットを受信完了した際、ACKの代わりに、RTSパケットを送信元の中継局に送信し、前記RTCパケットを受信した前記送信元の中継局は前記中継局がデータパケットを正常受信したと認識し且つ、RTSパケットに記述されているデータパケットの送信が完了するまでの時間、データパケット送信準備処理を停止する。前記RTSパケットを受信した次の中継局は、自身がデータパケット受信可能な状態であれば、SIFS間後、前記中継局宛てにCTSパケットを送信し、このCTSパケットを受信した前記中継局は、前記次の中継局がデータパケット受信可能な状態であることを認識し、SIFS間後、前記次の中継局宛に前記データパケットを送信する。



1

【特許請求の範囲】

【請求項１】 複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継局であって、

送信すべきデータ信号が発生した時に、ある一定時間Ｔｄの間キャリアセンスを実施して無線回線が空いていることを確認した後に次の中継局へ送信可能かどうかを確認するための信号を送信する送信可確認機能と、

前記送信可確認機能により前記次の中継局がデータ信号を受信可能であることが確認できた時に、確認できてからある一定時間Ｔｓ（Ｔｓ＜Ｔｄ）後に前記データ信号を無線パケット信号として送信する無線パケット送信機能と、

自中継局の前の中継局から自中継局がデータ信号を受信可能であるかどうかを確認するための信号を受信した時に、受信可能であればその旨を通知する信号を前記前の中継局に送信する受信可通知機能と、

前記受信可通知機能により前記前の中継局が自中継局が受信可能であることを確認して無線パケット信号として送信してきたデータ信号を受信する無線パケット受信機能と、

前記無線パケット受信機能により受信したデータ信号を中継処理するために、次の中継局へ送信可能かどうかを確認するための信号を、該データ信号を受信し終わってからある一定時間Ｔｓ後に送信する中継可確認機能と、

前記中継可確認機能により前記次の中継局がデータ信号を受信可能であることが確認できた時に、確認できてからある一定時間Ｔｓ後に前記データ信号を無線パケット信号として送信する無線パケット中継機能と、

次の中継局が送信する、次の中継局の更に次の中継局に対する前記データ信号の送信が可能かどうかを確認する信号を自中継局が監視して、該信号の受信が確認できた時に、自中継局が中継したデータ信号を含む無線パケット信号が正常に受信されたことを確認する無線パケット信号中継確認機能を具備することを特徴とする無線パケット中継局。

【請求項２】 複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継方法にあって、

中継局が送信元の中継局からのデータパケットを受信完了した際に、データパケットを正常受信したことを知らせるACKパケットの代わりに、データパケットが受信可能であるかどうかを判断するRTSパケットを前記送信元の中継局に送信するステップを含むことを特徴とする無線パケット中継方法。

【請求項３】 前記RTSパケットを受信した前記送信元の中継局は、前記中継局がデータパケットを正常受信したと認識し且つ、前記RTSパケットに記述されているデータパケットの送信が完了するまでの時間、データパケット送信準備処理を停止することを特徴とする請求項２記載の無線パケット中継方法。

2

【請求項４】 前記RTSパケットを受信した次の中継局は、自身がデータパケット受信可能な状態であれば、SIFS間後に前記中継局宛てに送信確認のためのCTSパケットを送信し、このCTSパケットを受信した前記中継局は、前記他の中継局がデータパケット受信可能な状態であることを認識し、SIFS間後に前記次の中継局宛に前記データパケットを送信することを特徴とする請求項２記載の無線パケット中継方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、データパケットを無線中継する無線パケット中継局及びこの無線パケット中継局における無線パケット中継方法に係り、特に、中継局が通信ルート上、次の中継局にデータパケットを送信する際に、通信ルート上前の中継局から送信されてきたデータパケットを素早く次の中継局へ送信する準備を行うことで、宛先局にデータパケットを素早く中継する技術に関するものである。

【０００２】

【従来の技術】親局の存在しない各局同士が自律的に回線を共有し合う無線パケット中継方法（無線アクセス方法）の従来技術としては、例えば、世界的な標準化作業を行っているIEEE802.11で定められているCSMA/CAのDCF（Distributed Coordination Function）の「RTS-CTS-DATA-ACK」手順が公知である。本手順は、「IEEE P802.11,Draft Standard for Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specification,P802.11 D6.1,9 May 1997」に記述されている。この無線アクセス方式を無線中継に適用する従来技術を以下に説明する。

【０００３】図４は、従来の無線中継局（無線パケット中継局）の中継手順を示した説明図である。中継局Ａは、受信したデータパケットを中継局Ｂへ、同じく中継局Ｂは中継局Ｃへ中継している例を示した図である。

【０００４】中継局Ａは、データパケットを受信し、データパケットの受信完了を示す肯定応答（ACK）パケットを送信した後、中継局Ｂへデータパケットを転送する処理に入る。中継局Ａは、DIFS（DCF Inter Frame Space)と呼ばれる間、他の端末が回線を使用しているかどうかを監視する（以下キャリアセンスと呼ぶ）。DIFS間、キャリアセンスを行った後、回線が使用されていないことを認識すると、次の処理に入る。

【０００５】ここで、DIFS間に回線が使用されていた場合、その後回線が空いて、再びDIFS時間のキャリアセンス後、乱数を発生させてその値で指定された間だけキャリアセンスを行うバックオフ処理に入る。各局がバックオフ処理を行うことで、他の局との衝突の確率を低減す

ることが可能となる。

【０００６】DIFS間、若しくは、DIFS間後のバックオフ処理を行った後、中継局Ａは、この間のキャリアセンスの結果、回線が使用されていないことを認識すると、中継局Ｂが、データパケットを受信可能な状態であるかを判断するためのRTSパケットを、データパケットの送信が完了するまでの時間を記述して、中継局Ｂ宛に送信する。

【０００７】RTSパケットを受信した中継局Ｂ以外の中継局は、中継局Ａがこれからデータパケットを送信しようとしていることを認識し、この中に記述されている時間後にDIFS間のキャリアセンスを始める。

【０００８】RTSパケットを受信した中継局Ｂは、データパケットを受信可能な状態であることを認識すると、SIFS（Short Inter Frame Space）と呼ばれる間隔で、送信確認のためのパケットであるCTSパケットを、中継局Ａがデータパケットの送信を完了するまでの時間を記述して、中継局Ａ宛に送信する。

【０００９】CTSパケットを受信した中継局Ａ以外の中継局（例えば中継局Ｃ）は、中継局Ｂがデータパケットを受信しようとしていることを認識し、この中に記述されている時間待機し、その後にDIFS間のキャリアセンスを始める。CTSパケットを受信した中継局Ａは、中継局Ｂが受信可能な状態であることを認識することが可能となり、SIFS間後に、データパケットを送信する。

【００１０】データパケットを受信した中継局Ｂは、データパケットを正常に受信したことを認識すると、SIFS間後、データパケットを正常に受信したことを伝えるACKパケットを送信する。上記と同様の処理を各中継局が繰り返し、宛先局までデータパケットの中継を行う。

【００１１】

【発明が解決しようとする課題】本発明が解決しようとする課題として、従来技術のシーケンス図である図４において、中継局Ｂがデータパケットの受信完了をして、ACKパケットを中継局Ａに送信した際に、中継局Ａに送信待ちのデータパケットがある場合を考える。中継局Ａ、Ｂは、データパケットを送信する準備に入るため、DIFS間キャリアセンスを行う。

【００１２】ここで、DIFS間内のキャリアセンスの結果、キャリアが空いていることが確認できた後に、各局は、乱数を発生させて、その値で指定された時間だけキャリアセンスを続けるバックオフ処理を開始する。この際に、中継局Ａが中継局Ｂよりも小さい値で送信可能となった場合に、中継局Ｂは、中継局ＡからのRTSパケットを受信すると、中継局Ａからのデータパケットの送信を完了するまでの間、データパケット送信準備を控えることになる。

【００１３】繰り返しこのような場合が存在したり、また、中継回数が多くなる場合に、中継局Ｂが中継局Ｃにデータパケットを中継する時間が遅くなり、宛先局への

データパケットのスループットが低くなるという問題点がある。

【００１４】また、本発明が解決しようとする課題の１つとして、上記の場合で、バックオフ処理の際に、中継局Ｂが先にデータパケットを送信したとしても、中継局Ａが送信したデータパケットの送信を開始する（RTSを送信する）までに、ACK送信時間＋SIFS時間＋DIFS時間（＋バックオフ処理時間）の時間を経ることになる。そのため、データパケットの中継が遅くなり、スループットが低くなるという問題点がある。

【００１５】本発明の目的は、上記課題を解決されるためになされたもので、データパケットの中継処理に掛かる時間を短縮することができ、且つデータパケットが中継局に滞らず宛先局に迅速に送信できる無線パケット中継局及び無線パケット中継方法を提供することを目的としている。

【００１６】

【課題を解決するための手段】上記目的を達成するために、請求項１の発明の特徴は、複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継局であって、送信すべきデータ信号が発生した時に、ある一定時間Ｔｄの間キャリアセンスを実施して無線回線が空いていることを確認した後に次の中継局へ送信可能かどうかを確認するための信号を送信する送信可確認機能と、前記送信可確認機能により前記次の中継局がデータ信号を受信可能であることが確認できた時に、確認できてからある一定時間Ｔｓ（Ｔｓ＜Ｔｄ）後に前記データ信号を無線パケット信号として送信する無線パケット送信機能と、自中継局の前の中継局から自中継局がデータ信号を受信可能であるかどうかを確認するための信号を受信した時に、受信可能であればその旨を通知する信号を前記前の中継局に送信する受信可通知機能と、前記受信可通知機能により前記前の中継局が自中継局が受信可能であることを確認して無線パケット信号として送信してきたデータ信号を受信する無線パケット受信機能と、前記無線パケット受信機能により受信したデータ信号を中継処理するために、次の中継局へ送信可能かどうかを確認するための信号を、該データ信号を受信し終わってからある一定時間Ｔｓ後に送信する中継可確認機能と、前記中継可確認機能により前記次の中継局がデータ信号を受信可能であることが確認できた時に、確認できてからある一定時間Ｔｓ後に前記データ信号を無線パケット信号として送信する無線パケット中継機能と、次の中継局が送信する、次の中継局の更に次の中継局に対する前記データ信号の送信が可能かどうかを確認する信号を自中継局が監視して、該信号の受信が確認できた時に、自中継局が中継したデータ信号を含む無線パケット信号が正常に受信されたことを確認する無線パケット信号中継

確認機能を具備することにある。

【００１７】請求項２の発明の特徴は、複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継方法にあって、中継局が送信元の中継局からのデータパケットを受信完了した際に、データパケットを正常受信したことを知らせるACKパケットの代わりに、データパケットが受信可能であるかどうかを判断するRTSパケットを前記送信元の中継局に送信するステップを含むことにある。

【００１８】請求項３の発明の特徴は、前記RTSパケットを受信した前記送信元の中継局は、前記中継局がデータパケットを正常受信したと認識し且つ、前記RTSパケットに記述されているデータパケットの送信が完了するまでの時間、データパケット送信準備処理を停止することにある。

【００１９】請求項４の発明の前記RTSパケットを受信した次の中継局は、自身がデータパケット受信可能な状態であれば、SIFS間後、前記中継局宛てに送信確認のためのCTSパケットを送信し、このCTSパケットを受信した前記中継局は、前記他の中継局がデータパケット受信可能な状態であることを認識し、SIFS間後、前記次の中継局宛に前記データパケットを送信する。

【００２０】本発明によれば、中継局が送信元の中継局からのデータパケットを受信完了した際、ACKの代わりに、RTSパケットを送信元の中継局に送信する手順とすることにより、データパケットの中継処理に掛かる時間を短縮すると共に、データパケットが中継局に滞って宛先局に迅速に送信できなくなることを無くしている。

【００２１】

【発明の実施の形態】以下、本発明の実施の形態を図面に基づいて説明する。図１は、本発明の無線パケット中継局の一実施形態の構成を示したブロック図である。無線パケット中継局は、無線送受信機１、通信ルート制御部２、通信ルート情報記憶部３、データパケット中継部４、ACKパケット送信部５、ACKパケット受信部６、RTSパケット送信部７、RTSパケット受信部８、CTSパケット送信部９、CTSパケット受信部１０、NAV処理部１１、DIFSタイマ処理部１２、SIFSタイマ処理部１３、バックオフ処理部１４、キャリアセンス処理部１５を備えている。

【００２２】ここで、無線送受信機１は当該無線パケット中継局と他の無線パケット中継局との間で無線通信を行う。通信ルート制御部２は、通信ルート情報記憶部３で記憶された通信ルート情報をもとに、各パケットを送信する際の局のアドレス等の管理を行う。データパケット中継部４は、受信したデータパケットを保持し、通信ルート制御部２により得られたアドレス等を参照して、データパケットを中継する準備を行う。ACKパケット送

信部５は、正常にデータパケットを受信できたことを確認すると、その旨を伝えるためのACKパケットを作成し、送信のための準備を行う。

【００２３】ACKパケット受信部６は、ACKパケットを受信した後、正常に送信相手の局にデータパケットの送信を完了したことの認識を行う。RTSパケット送信部７は、データパケットの送信要求がある際に、RTSパケットを作成し、データパケットの送信が完了する時間(Duration)を記述して送信の準備を行う。RTSパケット受信部８は、局から送信されたRTSパケットを受信した後、送信先のアドレスを認識し、送信先が、自身の端末であった場合に、CTSパケット送信部９に移り、送信先が、自身の端末でなかった場合に、NAV処理部１１へ移る。

【００２４】CTSパケット送信部９は、RTSパケット受信部８より、CTSパケット作成の要求があった場合に、CTSパケットを作成し、データパケットの送信が完了する時間（Duration）を記述して送信の準備を行う。CTSパケット受信部１０は、CTSパケットを受信した後、送信先のアドレスを認識し、送信先が、自身の端末であった場合には、データパケット中継部４でデータパケット送信の準備に移り、送信先が、自身の端末でなかった場合には、NAV処理部１１へ移る。

【００２５】NAV処理部１１は、RTS若しくはCTS中に記述されたDuration時間まで、データパケット送信準備処理であるRTS（DIFSタイマ＋バックオフ処理）、CTSパケットの送信処理の待機を行う。DIFSタイマ処理部１２は、データパケット送信要求があった際に、あらかじめ設定されているDIFS時間だけの間、キャリアセンス処理部１５によりキャリアセンスを行い、他の局からのパケットの送信がないかどうかの監視を行う。他の局からのパケットの処理を認識すると、パケットの送信が終り回線が空いた瞬間から、DIFSタイマを再び開始し、タイマ満了したのち、バックオフ処理部１４に移る。SIFSタイマ処理部１３は、CTSパケット及びACKパケット及びデータパケットの送信要求があった際に、あらかじめ設定されているSIFS時間だけの間、送信の準備を行う。

【００２６】バックオフ処理部14は、DIFSタイマ処理部１２において、バックオフ処理でDIFSタイマが時間満了となった際に、乱数を発生させ、指定した時間キャリアセンス処理部１５によりキャリアセンスを行い、他のパケットからの送信がないかどうかの監視を行う。ここで、他の局からのパケットの送信を認識すると、DIFSタイマ処理部１２へ移る。

【００２７】図２は、本発明の無線パケット中継方法の一実施形態を示した説明図であり、図１に示した構成の無線パケット中継局Ａからデータパケットを無線パケット中継局Ｂを介して無線パケット中継局Ｃに送信する際の送受信手順を説明している。

【００２８】図３は図２に示した送受信手順で無線パケット中継局Ａからデータパケットを無線パケット中継局

Ｂを介して無線パケット中継局Ｃに送信する際の各局の動作を示したシーケンス図である。

【００２９】次に本実施形態の動作を図２及び図３を参照して説明する。図２と図３は、送信元局Ａから、中継局Ｂ、Ｃの順にデータパケットを中継している状況を示している。送信元局Ａは、データパケット送信の要求があった場合に（ステップ３０１ａ）、RTSパケットを準備する。送信元局Ａは、RTSパケットを送信する際に、従来技術と同じく、DIFSと呼ばれる間キャリアセンスを行う（ステップ３０２ａ）。DIFS間キャリアセンスを行った後、他の局からパケットが送信されてなく、回線が空いていることを認識すると、RTSパケットを中継局Ｂ宛に送信する（ステップ３０３ａ）。RTSパケット中には、送信元局Ａから中継局Ｂへデータパケットの送信を完了するまでに要する時間を記述している。

【００３０】もし、ここで、DIFS間のキャリアセンス中に、他の局からのパケット送信を確認すると、他の局のパケットの送信が完了し、回線が空いていると認識した瞬間から、再び、DIFSタイマを開始する。DIFSタイマ完了の後、乱数を発生させ、その値で指定された間だけキャリアセンスを行うバックオフ処理に入る。その間、他の局からのパケットの送信を感知しないと、RTSパケットを送信する。

【００３１】中継局Ｂは、RTSパケットを受信すると、送信元局Ａからのデータパケットを受信可能な状態であるかどうかを判断する（ステップ３０１ｂ）。受信可能な状態でなければ、返答をしない（ステップ３０２ｂ）。もし、受信可能な状態であれば、SIFSと呼ばれる時間の経過を待ち（ステップ３０３ｂ）、送信元局Ａ宛にCTSパケットを送信する（ステップ３０４ｂ）。CTSパケットもRTSパケット同様、送信元局Ａから中継局Ｂへデータパケットの送信を完了するまでに要する時間を記述している。

【００３２】ここで、CTSパケットを受信した送信元局Ａ以外の中継局（例えば、中継局Ｃ）は、CTSパケット中に記述されている時間だけ、NAVを設定してデータパケット送信準備の処理を停止する。

【００３３】CTSパケットを受信した送信元局Ａは、中継局Ｂがデータパケット受信可能な状態であることを認識することが可能となり、SIFS間経過を待ち（ステップ３０４ａ）、中継局Ｂ宛にデータパケットを送信する（３０５ａ）。データパケットを正常に受信した中継局Ｂは、SIFS間経過するのを待ち（ステップ３０５ｂ）、通信ルート上、次の中継局である中継局Ｃ宛にRTSパケットを送信する（ステップ３０６ｂ）。

【００３４】RTSパケットを受信した送信元局Ａは、本来データパケットの正常送信完了を通知するACKパケットを受信する時間に、RTSパケットを受信することで、中継局Ｂへのデータパケットの送信が正常に完了したことを認識する。その後、送信元局Ａは中継局Ｂが中継局Ｃ宛のデータパケットの送信を完了するまでの間、NAVを設定し、データパケット送信準備処理を停止する。

【００３５】RTSパケットを受信した中継局Ｃは、自身がデータパケット受信可能な状態であるかどうかを判断する（ステップ３０１ｃ）。受信可能な状態でなければ、返答をしない（ステップ３０２ｃ）。もし、受信可能な状態であれば、SIFS間経過するのを待ち（ステップ３０３ｃ）、中継局Ｂ宛にCTSパケットを送信する（ステップ３０４ｃ）。

【００３６】CTSパケットを受信した中継局Ｂは、中継局Ｃがデータパケット受信可能な状態であることを認識することが可能となり、SIFS間経過するのを待ち（ステップ３０７ｂ）、中継局Ｃ宛にデータパケットを送信する（ステップ３０８ｂ）。データパケットを正常に受信した中継局Ｃは、SIFS間経過後（ステップ３０５ｃ）、通信ルート上、次の中継局である中継局宛にRTSパケットを送信する（ステップ３０６ｃ）。各中継局において以上の処理が、宛先局にデータパケットが届けられるまで繰り返されることで、データパケットの中継が行われる。

【００３７】本実施形態によれば、中継局Ｂが中継局Ａからのデータパケットを受信完了した際、ACKでなく、RTSパケットを中継局Ａに送信するため、この時に、中継局Ａに送信待ちのデータパケットがある場合でも、中継局Ｂのみが SIFS間後、受信した前記データパケットを中継局Ｃに迅速に送ることができる。これにより、中継局Ｂにデータパケットが滞って、データパケットの中継処理がなかなか出来なくなることを防止することができる。

【００３８】又、本来、データパケットが受信可能かどうかを判断するRTSパケットに、データパケットの正常受信完了を通知するACKパケットの機能を保持させることで、ACK送信時間＋DIFS時間（＋バックオフ処理時間）に相当する時間を短縮することができ、データパケットの中継処理に掛かる時間を短縮して、宛先へのスループットを高くすることができる。

【００３９】

【発明の効果】以上詳細に説明したように、本発明の無線パケット中継局及び無線パケット中継方法を用いることにより、送信元局から宛先局まで、中継局を用いてデータパケットを中継させる際に、送信確認のリクエストを行うRTSパケットに、データパケットの正常受信完了を通知するACKパケットの機能を保持させることで、ACK送信時間＋DIFS時間（＋バックオフ処理時間）に相当する時間を短縮することができ、中継局が素早くデータパケットの中継を行うことができる。これにより、データパケットの中継を優先的に行うことが可能となり、更に、送信元局が次のデータパケットの送信までの時間を短縮することが可能となることから、データパケットが中継局で滞ることがなくなり、宛先局に素早く中継でき

る効果がある。

【図面の簡単な説明】

【図１】　本発明の無線パケット中継局の一実施形態の構成を示したブロック図である。

【図２】　本発明の無線パケット中継方法の一実施形態を示した説明図である。

【図３】　図２に示した送受信手順で無線パケット中継局Ａからデータパケットを無線パケット中継局Ｂを介して無線パケット中継局Ｃに送信する際の各局の動作を示したシーケンス図である。

【図４】　従来の無線中継局（無線パケット中継局）の中継手順を示した説明図である。

【符号の説明】

１　無線送受信機

２　通信ルート制御部

＊

＊３　通信ルート情報記憶部

４　データパケット中継部

５　ACKパケット送信部

６　ACKパケット受信部

７　RTSパケット送信部

８　RTSパケット受信部

９　CTSパケット送信部

１０　CTSパケット受信部

１１　NAV処理部

１２　DIFSタイマ処理部

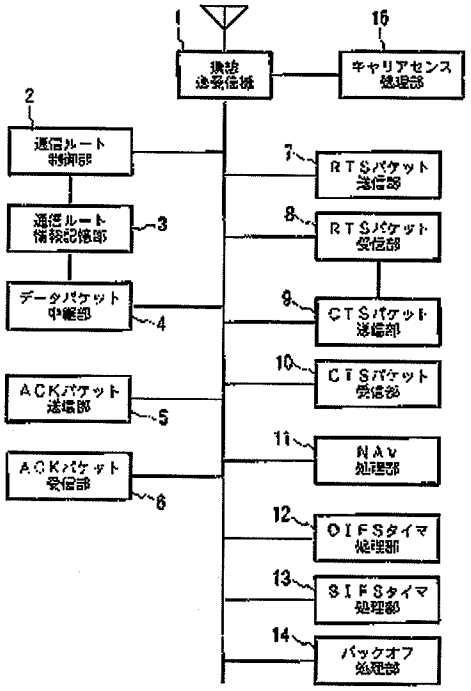
１３　SIFSタイマ処理部

１４　バックオフ処理部

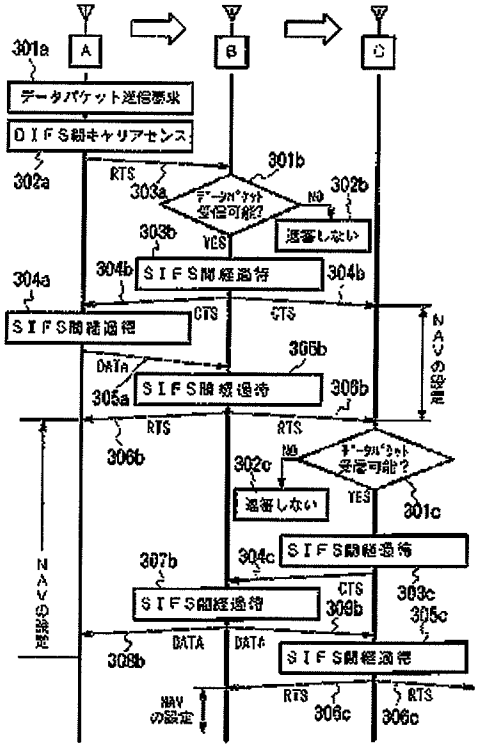
１５　キャリアセンス処理部

Ａ、Ｂ、Ｃ　無線パケット中継局

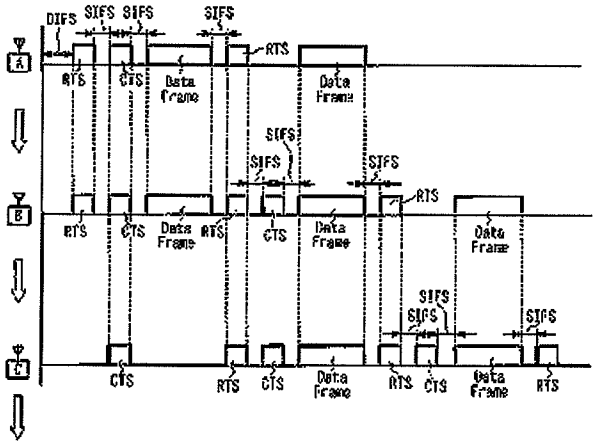
【図１】



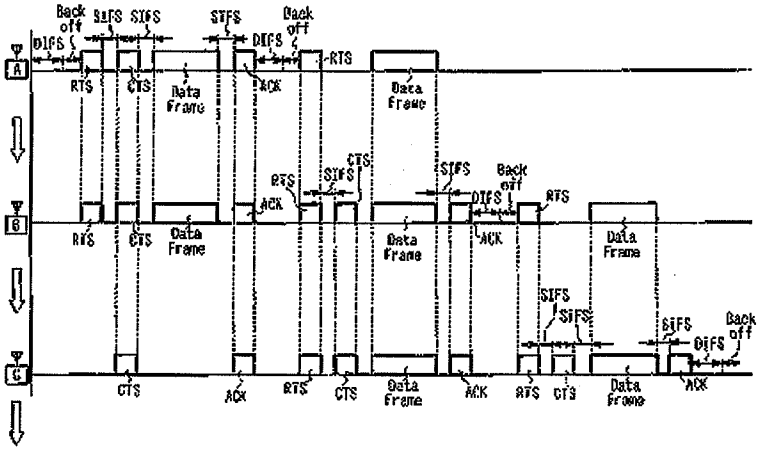
【図３】



【図２】



【図４】



【手続補正書】
【提出日】平成１２年３月１６日（２０００．３．１６）
【手続補正１】
【補正対象書類名】明細書
【補正対象項目名】請求項２
【補正方法】変更
【補正内容】
【請求項２】　複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継方法にあって、
中継局が送信元の中継局からのデータパケットを受信完了した際に、データパケットを正常受信したことを前の中継局に知らせるACKパケットの代わりに、次の中継局に対してデータパケットが受信可能であるかどうかを判断するためのRTSパケットを送信するステップを含むことを特徴とする無線パケット中継方法。
【手続補正２】
【補正対象書類名】明細書
【補正対象項目名】００１７
【補正方法】変更
【補正内容】
【００１７】請求項２の発明の特徴は、複数の無線局が共通の無線キャリアを使用して、自立分散的に無線パケ

ット信号を中継処理することで無線パケット信号を所望の無線局へ送信する通信システムにおける無線パケット中継方法にあって、中継局が送信元の中継局からのデータパケットを受信完了した際に、データパケットを正常受信したことを前の中継局に知らせるACKパケットの代わりに、次の中継局に対してデータパケットが受信可能であるかどうかを判断するためのRTSパケットを送信するステップを含むことにある。

【手続補正３】
【補正対象書類名】明細書
【補正対象項目名】００２０
【補正方法】変更
【補正内容】
【００２０】本発明によれば、中継局が送信元の中継局からのデータパケットを受信完了した際、データパケットを前の中継局に知らせるためのACKの代わりに、次の中継局に対してデータパケットが受信可能であるかどうかを判断するためのRTSパケットを送信することにより、データパケットの中継処理に掛かる時間を短縮すると共に、データパケットが中継局に滞って宛先局に迅速に送信できなくなることを無くしている。

【手続補正４】
【補正対象書類名】明細書
【補正対象項目名】００３４
【補正方法】変更 ＊
＊【補正内容】
【００３４】RTSパケットを受信した送信元局Ａは、前記中継局Ｂから中継局Ｃ宛のRTSパケットを、本来データパケットの正常送信完了を通知するACKパケットを受信する時間に受信することができるので、このRTSパケットを受信することによって、中継局Ｂへのデータパケットの送信が正常に完了したことを認識する。その後、送信元局Ａは中継局Ｂが中継局Ｃ宛のデータパケットの送信を完了するまでの間、NAVを設定し、データパケット送信準備処理を停止する。

【手続補正５】
【補正対象書類名】明細書
【補正対象項目名】００３７
【補正方法】変更
【補正内容】
【００３７】本実施形態によれば、中継局Ｂが中継局Ａからのデータパケットを受信完了した際、ACKパケットの代わりに中継局ＣへのRTSパケットを中継局Ａは受信することができ、中継局Ｂへの送信が正常に終了した旨を認識することができるので、この時に、中継局Ａに送信待ちのデータパケットがある場合でも、中継局Ｂのみがsifs間後、受信した前記データパケットを中継局Ｃに迅速に送ることができる。これにより、中継局Ｂにデータパケットが滞って、データパケットの中継処理がなかなか出来なくなることを防止することができる。

フロントページの続き

(51)Int.Cl.'	識別記号	Ｆｉ		ﾃｰﾏｺｰﾄﾞ(参考)
Ｈ０４Ｌ 29/08		Ｈ０４Ｌ 13/00	３０７Ｚ	

(72)発明者 守倉 正博
東京都千代田区大手町二丁目３番１号 日本電信電話株式会社内

Ｆターム(参考) 5K030 GA01 HA08 JA11 JL01
5K033 AA02 CC01 DA17
5K034 AA01 EE03 EE11 FF11 HH01 HH02
5K067 AA15 BB21 CC08 DD18 EE02 EE06 EE10 GG01 GG11 HH23
5K072 AA16 BB02 BB27 CC02 CC35 DD16 DD17 EE04 FF03 FF04 FF12 FF27 GG11 GG14